

**WHAT IS CLAIMED IS:**

1. An electroporation system for introducing foreign materials into cells by electroporating cell membranes by way of applying an electric pulse or electric pulses to a specimen including the cells, comprising:
  - an electroporation apparatus; and
  - a pulse generator for generating an electric pulse,wherein the electroporation apparatus further comprises: a long hollow specimen-stuffing member of non-conductive material; a reservoir so connected as to fluidly communicate with a distal end of the specimen-stuffing member; and a pressure maintaining means connected to the other distal end of the hollow specimen-stuffing member to fluidly communicate via a connector disposed with an electrode insertion unit,
  - the reservoir is disposed with an electrode contacting the specimen or an electrolytic solution, the specimen-stuffing member is filled with the specimen by the pressure maintaining means, the specimen or the electrolytic solution filled in the reservoir is connected to a distal end of the specimen-stuffing member for fluid communication, and an electric pulse or electric pulses are applied to an electrode contacting the specimen or the electrolytic solution filled in the reservoir and the other electrode inserted into the electrode insertion unit of the connector to thereby electroporate the cells in the specimen filled in the specimen-stuffing member.

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2. The system according to claim 1, wherein the specimen-stuffing member has a ratio ( $R$ ,  $\text{cm}^{-1}$ ) of longitudinal length ( $L$ ,  $\text{cm}$ ) to horizontal cross-sectional area ( $A$ ,  $\text{cm}^2$ ) in the range of 1/50 to 1/10,000.

3. The system according to claim 1 or 2, wherein the hollow specimen-stuffing member is a capillary, a tubing or a channel.

4. The system according to claim 1 or 2, wherein more than two electroporation apparatuses are arranged in parallel.

5. An electroporation system for introducing foreign materials into cells by electroporating cell membranes by way of applying an electric pulse or electric pulses to a specimen including the cells, comprising:

an electroporation apparatus; and

a pulse generator for generating an electric pulse,

wherein the electroporation apparatus further comprises: a long hollow specimen-stuffing member of non-conductive material; a pressure maintaining means connected to a distal end of the hollow specimen-stuffing member for fluid communication; a reservoir connected to the other distal end of the specimen-stuffing member for fluid communication and disposed with an electrode contacting the specimen or an electrolytic solution; and a reservoir holder equipped with a fixing unit for fixing the pressure maintaining means, an electrode terminal electrically connected to the fixing unit and an electrode terminal electrically connected to the electrode disposed at the reservoir,

wherein the pressure maintaining means is a pipette disposed at part of the body thereof with a conductive contact, and a movable electrode disposed inside the specimen-stuffing member is inserted for communication with a piston, and

wherein the hollow specimen-stuffing member is directly detached and attached to a tip mounted shaft of the pipette, the movable electrode is raised or lowered to a distal end of the specimen-stuffing member by a depression button of the pipette to fill the specimen in the specimen-stuffing member or retrieve it, the pipette is inserted and fixed to a reservoir holder inner pipe, a contact body(삭제) of the pipette body is electrically connected to the electrode terminal via the fixing unit of the reservoir holder inner pipe, the specimen-stuffing member is so positioned as to fluidly communicate with the specimen or the electrolytic solution stored in the reservoir, and an electric pulse or electric pulses are applied to the electrode contacting the specimen or the electrolytic solution stored in the reservoir to thereby electroporate the cells in the specimen filled in the specimen-stuffing member.

6. The system according to claim 4, wherein the specimen-stuffing member has a ratio ( $R, \text{cm}^{-1}$ ) of a longitudinal length ( $L, \text{cm}$ ) to horizontal cross-sectional area ( $A, \text{cm}^2$ ) in the range of 1/50 to 1/10,000.

7. The system according to claim 5 or 6, wherein the hollow specimen-stuffing member is a capillary or a tubing .

8. The system according to claim 5 or 6, wherein the movable electrode is a plastic of which surface is coated with conductive material.

9. The system according to claim 5 or 6, wherein more than two electroporation apparatuses are arranged in parallel.

10. An electroporation system for introducing foreign materials into cells by electroporating cell membranes by way of applying an electric pulse or electric pulses to a specimen including the cells, comprising:

an electroporation apparatus; and

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a pulse generator for generating an electric pulse,

wherein the electroporation apparatus further comprises: a long hollow specimen-stuffing member of non-conductive material; a pair of wells formed on the same substrate as that of the hollow specimen-stuffing member and so connected to both distal ends of the specimen-stuffing member for fluid communication, and electrodes for applying an electric pulse or electric pulses to the specimen by the pulse generator, and

wherein the electrodes are inserted in the wells through which the electric pulses are applied to thereby electroporate the cells in the specimen-stuffing member.

11. The system according to claim 10, wherein the specimen-stuffing member has a ratio ( $R$ ,  $\text{cm}^{-1}$ ) of a longitudinal length ( $L$ ,  $\text{cm}$ ) to horizontal cross-sectional area ( $A$ ,  $\text{cm}^2$ ) in the range of 1/50 to 1/10,000.

12. The system according to claim 10 or 11, wherein the hollow specimen-stuffing member is made of a micro channel or micro channels.

13. The system according to claim 10 or 11, wherein more than two electroporation apparatuses are arranged in parallel.

14. An electroporation system for introducing foreign materials into cells by electroporating cell membranes by way of applying an electric pulse or electric pulses to a specimen including the cells, comprising:

an electroporation apparatus; and

a pulse generator for generating an electric pulse,

wherein the electroporation apparatus further comprises: a long hollow specimen-stuffing member of non-conductive material; a pair of reservoirs

connected to both distal ends of the specimen-stuffing member for fluid communication, and

the reservoirs are disposed with electrodes for contacting the specimen or an electrolytic solution and an electric pulse or electric pulses are applied to the electrodes contacting the specimen or the electrolytic solution stored in the reservoirs, thereby electroporating the cells in the specimen filled in the specimen-stuffing member.

15. The system according to claim 14, wherein the specimen-stuffing member has a ratio ( $R, \text{cm}^{-1}$ ) of a longitudinal length ( $L, \text{cm}$ ) to horizontal cross-sectional area ( $A, \text{cm}^2$ ) in the range of 1/50 to 1/10,000.

16. The system according to claim 14 or 15, wherein the hollow specimen-stuffing member is a capillary or a tubing .

17. The system according to claim 14 or 15, wherein more than two electroporation apparatuses are arranged in parallel.

18. An electroporation apparatus for applying an electric pulse or electric pulses to a specimen including cells to thereby electroporate cell membranes and infuse foreign materials into the cells, comprising:

a long hollow specimen-stuffing member of non-conductive material; a reservoir connected to a distal end of the specimen-stuffing member for fluid communication; and a pressure maintaining means connected to the other distal end of the specimen-stuffing member for fluid communication.

19. The electroporation apparatus according to claim 18, wherein the specimen-stuffing member has a ratio ( $R, \text{cm}^{-1}$ ) of a longitudinal length ( $L, \text{cm}$ ) to horizontal cross-sectional area ( $A, \text{cm}^2$ ) in the range of 1/50 to 1/10,000.

20. The electroporation apparatus according to claim 18 or 19, wherein the hollow specimen-stuffing member is a capillary, a tubing or a channel.

21. The electroporation apparatus according to claim 18 or 19, wherein the pressure maintaining means is connected by a connector disposed with electrode insertion unit for inserting the electrode.

22. The electroporation apparatus according to claim 21, wherein the electrode is inserted into the electrode insertion unit for applying electric pulses, and the electrode contact the specimen if the specimen-stuffing member is filled therein with the specimen.

23. The electroporation apparatus according to claim 21, wherein the connector is a disc for forming a hole therein for passing the specimen, and the electrode insertion unit is formed at a lateral surface of the disc.

24. The electroporation apparatus according to claim 18 or 19, wherein the pressure maintaining means is a pump, a syringe or a pipette.

25. An electroporation apparatus for applying an electric pulse or electric pulses to a specimen including cells to thereby electroporate cell membranes and infuse foreign materials into the cells, comprising:

a long hollow specimen-stuffing member of non-conductive material; a pressure maintaining means connected to a distal end of the specimen-stuffing member for fluid communication; a reservoir connected to the other distal end of the specimen-stuffing member for fluid communication and disposed with the electrode for contacting the specimen or an electrolytic solution; and a reservoir holder including a fixing unit for fixing the pressure maintaining means, an electrode terminal for electrically connecting the fixing unit and an electrode terminal for electrically connecting the electrode disposed at the reservoir.

26. The electroporation apparatus according to claim 25, wherein the pressure maintaining means is a pipette in which a conductive contact is disposed at part of the pipette body thereof and a movable electrode is inserted for communication with a piston, and wherein the hollow specimen-stuffing member is directly attached and detached to a tip mounting shaft of the pipette.

27. The electroporation apparatus according to claim 25 or 26, wherein the hollow specimen-stuffing member is a capillary or a tubing.

28. The electroporation apparatus according to claim 25 or 26, wherein the specimen-stuffing member has a ratio ( $R, \text{cm}^{-1}$ ) of a longitudinal length ( $L, \text{cm}$ ) to horizontal cross-sectional area ( $A, \text{cm}^2$ ) in the range of 50 to 10,000.

29. An electroporation apparatus for applying an electric pulse or electric pulses to a specimen including cells to thereby electroporate cell membranes and infuse foreign materials into the cells, comprising:

a long hollow specimen-stuffing member of non-conductive material; and  
a pair of reservoirs connected to both distal ends of the specimen-stuffing member for fluid communication.

30. The electroporation apparatus according to claim 29, wherein the specimen-stuffing member has a ratio ( $R, \text{cm}^{-1}$ ) of a longitudinal length ( $L, \text{cm}$ ) to horizontal cross-sectional area ( $A, \text{cm}^2$ ) in the range of 1/50 to 1/10,000.

31. The electroporation apparatus according to claim 28 or 29, wherein the hollow specimen-stuffing member is a capillary or a tubing.

32. An electroporation apparatus for applying an electric pulse or electric pulses to a specimen including cells to thereby electroporate cell membranes and infuse foreign materials into the cells, comprising:

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a long hollow specimen-stuffing member of non-conductive material; and a pair of wells formed on the same substrate as that of the hollow specimen-stuffing member and so connected to both distal ends of the specimen-stuffing member for fluid communication.

33. The electroporation apparatus according to claim 32, wherein the specimen-stuffing member has a ratio ( $R$ ,  $\text{cm}^{-1}$ ) of a longitudinal length ( $L$ ,  $\text{cm}$ ) to horizontal cross-sectional area ( $A$ ,  $\text{cm}^2$ ) in the range of 1/50 to 1/10,000.

34. The electroporation apparatus according to claim 32 or 33, wherein the hollow specimen-stuffing member is comprised of a micro channel.

35. The electroporation apparatus according to claim 32 or 33, wherein more than two channels of the hollow specimen-stuffing members are connected to a pair of wells for fluid communication.

36. The electroporation apparatus according to claim 35, wherein each channel length of the channels is different.

37. The electroporation apparatus according to claim 35, wherein each width of the channels is different.

38. The electroporation apparatus according to claim 35 further comprising an upper substrate and a lower substrate, wherein the upper substrate is formed with a hole in which a well is formed, and the upper substrate or the lower substrate is formed with the channels which are depressed.

39. An electroporation method for applying an electric pulse or electric pulses to a specimen including cells to electroporate cell membranes and infuse foreign materials into the cells, wherein a long and hollow specimen-stuffing member of non-conductive material is filled with the specimen and an electric



pulse or electric pulses are applied to both distal ends so that a current can flow through the specimen.

40. The method according to claim 39, wherein the hollow specimen-stuffing member has a ratio ( $R$ ,  $\text{cm}^{-1}$ ) of a longitudinal length ( $L$ ,  $\text{cm}$ ) to horizontal cross-sectional area ( $A$ ,  $\text{cm}^2$ ) in the range of 1/50 to 1/10,000.

41. The method according to claim 39 or 40, wherein the hollow specimen-stuffing member is a capillary, a tubing or a channel.

42. The method according to claim 39 or 40, wherein the electroporation in the specimen-stuffing member is continuously conducted.